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EDITORIAL

CT colonography ('virtual colonoscopy'): Is it ready for colorectal cancer screening?

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Colorectal cancer is the fourth leading cause of cancer death worldwide[1] but is largely preventable. Most colorectal cancers arise from benign adenomatous polyps, which grow slowly. Thus colorectal cancer is highly suited to screening because of its long preclinical phase during which it is detectable and curable[2]. Multiple organizations including the World Health Organization (WHO), the American Cancer Society (ACS), the Agency for Health Care Policy and Research (AHCPR), the US Preventive Service Task Force (USPSTF), and the American Gastroenterology Association (AGA) have issued or endorsed guidelines for colorectal cancer screening. The screening tests endorsed by these organizations include fecal occult blood testing, flexible sigmoidoscopy, air-contrast barium enema, and colonoscopy.

Unfortunately, screening programs for colorectal cancer have been only partly successful, owing largely to poor patient compliance with screening recommendations[3,4]. Recent studies indicate compliance rates of only approximately 30%[5,6]. Major obstacles to patient acceptance of colorectal cancer screening with colonoscopy are the requirement for a rigorous bowel preparation, the invasiveness of the procedure and the need for sedation.

Computed tomography colonography (CTC) (also known as 'virtual colonoscopy') is a more recently developed test, which has not yet been endorsed as a colorectal cancer screening test, although it has been shown to be useful for certain clinical indications. Many radiologists are optimistic that CTC eventually will become an important screening test for colorectal cancer, but some radiologists already are offering it to patients directly. Is this practice appropriate or is it premature? This editorial addresses the question, 'Is virtual colonoscopy ready to be used as a screening test for colorectal cancer?'

CTC has a number of potential advantages compared with conventional fiberoptic colonoscopy. It is a non-invasive technique, requires no sedation, and can be completed in a much shorter time. The majority of studies assessing the relative acceptability of CTC and conventional colonoscopy in patients who have undergone both tests on the same day have demonstrated a preference for CTC[7–11]. CTC is also safer than colonoscopy. Colon perforation occurs in 1 : 1000 patients who undergo conventional colonoscopy, and the mortality rate is 1 : 5000[12–17]. Although experience with CTC is much more limited, no CTC related colon perforations have been reported, and it is likely that the morbidity and mortality associated with CTC will be similar to those for air-contrast barium enema (perforation rate of 1 : 10 000 and mortality rate of 1 : 50 000)[18–20]. CTC has the potential to examine the colon completely in nearly all patients, whereas conventional colonoscopy is incomplete in 5–10% of average patients[21]. In addition, CTC eliminates blind spots that can be problematic with conventional colonoscopy. For example, CT colonography is able to demonstrate lesions behind haustral folds and beyond bends in the colon because of its ability to provide an endoluminal view of the colon in both forward and reverse directions and its ability to demonstrate the colon in both 2- and 3-dimensional perspectives. For the same reasons, localization of colonic lesions is more accurate with CTC than with fiberoptic colonoscopy.

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On the other hand, CTC has some limitations. Pitfalls that can result in false-negative diagnoses include retained fluid, which can obscure lesions, incomplete distention of some colonic segments, and inability to demonstrate flat lesions. Pitfalls that can result in false-positive diagnoses include retained stool and nodular folds, which can be mistaken for polyps. An important disadvantage of CTC compared with colonoscopy is that CTC does not allow biopsy or removal of polyps that are identified. In addition, although CTC has been shown to have sensitivity and specificity similar to fiberoptic colonoscopy for detecting $\geq$10 mm polyps in high risk populations[22–25], it has not been shown to have similar accuracy in patients who are at average risk for colorectal cancer[26]. Furthermore, the CTC studies published to date have been performed in academic centers by experienced radiologists with expertise in colonic imaging. The diagnostic performance of CTC in a general practice environment has not been tested.

Although no published studies have yet demonstrated the efficacy of CTC in a screening setting, several studies have demonstrated its usefulness in patients who have undergone an incomplete colonoscopy[27,28] or in patients with an occlusive colon carcinoma[29]. CTC also can be useful for patients who have a contraindication to conventional colonoscopy.

Despite the tremendous promise of CTC, evidence to support its use as a technique for colorectal cancer screening is currently lacking. Nevertheless, studies performed over the next five years may provide that evidence. Well controlled large scale prospective clinical trials are necessary to determine the efficacy of CTC in a screening setting.

If CTC will eventually play a major role in colorectal cancer screening, several important issues will have to be addressed.

- *Cost:* The cost of CTC will have to be competitive with that of conventional colonoscopy.

- *Patient acceptance:* The examination will have to be more acceptable to patients than conventional colonoscopy. A number of studies have demonstrated that this already is the case[7,8,10,11]. In addition, use of 'electronic bowel cleansing' (i.e. tagging stool with ingested contrast material and then subtracting the radiodense material from the CT image) may obviate a cathartic bowel preparation, further increasing patient acceptance of CTC[30–33].

- *Sensitivity and Specificity:* Ideally, the sensitivity of CTC should be competitive with that of fiberoptic colonoscopy. However, even if the sensitivity of CTC is somewhat lower than that of colonoscopy, the test can have a large impact on preventing colorectal cancer, if it is significantly more acceptable to patients, enabling a higher percentage of patients to be screened. In addition, the specificity of CTC will have to be reasonably high to avoid large numbers of unnecessary colonoscopies prompted by false-positive examinations. A great deal of investigation is currently underway to develop effective computer aided diagnosis (CAD) systems to help improve polyp detection with CTC[34–36]. Additionally, continued improvements in multislice CT systems combined with improved software for image evaluation have recently improved the overall effectiveness of CTC.

- *Radiation dose:* The radiation dose of CTC examinations will have to be minimized for it to be acceptable as a widespread screening procedure. Recent studies have demonstrated that CTC can be performed effectively with X-ray doses equivalent to or less than those imparted by a barium enema examination[37–39].

Ultimately, the important issue is not whether CTC is better or worse than colonoscopy or other screening tests for colorectal polyp detection. The objective of colorectal cancer screening is to prevent cancers and save lives. The unfortunate fact is that current compliance for colorectal cancer screening programs is very low, and patients continue to die from colorectal cancers that could have been prevented. If implementation of a technique like CTC can improve colorectal cancer screening compliance, then many lives can be saved. My hope is that well designed, large scale clinical studies will demonstrate the effectiveness of CTC as a screening test for colorectal cancer. Until then, however, use of CTC for colorectal cancer screening is, in my opinion, premature.

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